Draft Suggestion to Decontaminate the Japanese Forest Areas,

The following suggestion is brief summary of a strategy to decontaminate the Japanese forest areas contaminated with Cesium. Much of this information is derived from the NCRP Report No. 154 entitled "Cesium-137 in the Environment: Radioecology and Approaches to Assessment and Management".

Behavior of Cesium in Terrestrial Ecosystems

Cesium transport in terrestrial ecosystems is governed by many factors which may vary over space and time. It may have already been observed by Japanese researchers that the cesium accumulation can vary by orders of magnitude between different biological components within a single environment and among different ecosystems. The transport of cesium through the environment involves a number of biogeochemical pathways. These include physical processes like atmospheric deposition on to soil or plant surfaces, soil erosion by wind and water, percolation into the soil profile, weathering effects, and animal or human intervention. Chemical processes included foliar absorption, plant uptake from the soil, translocation within the plant, and assimilation, distribution, and retention in animals or humans. For cesium, the concentration and transport can be described by its chemical properties and interactions with soil. Certain types of soil have a higher binding strength (e.g. enriched clay mineral composition) which could slow its transport and may reduce the potential for biological uptake. Other chemical factors can modify its transport (e.g., soil cation exchange capacity, pH, and potassium concentration of soil water).

Suggested Decontamination Strategy

The suggestion to decontaminate forest areas in Japan originates from these basic understandings of cesium transport in the environment. It makes use of phytoremediation and chemical treatment techniques known as phytoextraction and phytostabilization. Phytoextraction enhances cesium concentration into harvestable portions of plants. Phytostabilization uses plants to reduce cesium transport in the environment. Chemical amendment to the forest soil matrix may also be considered. For example, nitrogen and ammonium sulfate fertilizers increase uptake due to plant growth rates, while fertilizers with large amounts of potassium reduce cesium uptake. Application of illite-type 2:1 clays effectively immobilizes cesium and prevents bioavailability. A greater understanding the soil makeup is necessary to implement to the following decontamination strategy. The general approach is defined below:

1. Assess soil matrix of forest areas to be decontaminated.
2. Start from the highest altitudes and work toward lower altitudes.
3. Adjust soil matrix to enhance cesium transport through natural weathering processes to lower altitudes. (e.g., Nitrogen and ammonium sulfate fertilizers)
4. Install natural and man-made barriers:
    a. To diverts cesium enriched water/soil to a natural or man-made filter system
    b. To shield inhabitants from gamma radiation associated with the cesium enriched matrix

   c. To serve as a visible boundary for people who may visit the forest areas
   d. Location of barrier(s) should be determined by site-specific parameters
5. Install collection areas to filter cesium enriched water, allowing water to discharge naturally while capturing cesium. The distance and size of these collection areas should be determined on site-specific parameters. (e.g. illite-type 2:1 clays).
6. Below the natural barrier, adjust soil matrix to reduce cesium transport through natural weather processes to the city or village boundary. (e.g. illite-type 2:1 clays).
7. Initiate physical removal of the surface soil below the barriers to remove cesium contamination.

Advantages

1. Costs are minimal
2. Minimal impact to natural environment.
3. Enhances cesium migration through natural forces
4. Public can see where active remediation methods are being applied
5. Actions can be complete by local residents, gardeners, etc.
6. Barrier protects populations living below contaminated forest areas
7. Volume of waste can be controlled by deciding where to install the barriers.

Limitations

1. Time. It may take years to complete the remedial activity to target cleanup levels.
2. Construction of the natural / man-made barriers could affect local environment
3. Collection areas need to be monitored and replaced to prevent unnecessary radiation exposures.